CLAIMS

What is claimed is:

1. A method for fabricating an embossing tool, comprising the steps of:

providing a silicon substrate;

forming a first photoresist layer onto a top surface of said substrate;

exposing a portion of said photoresist layer at a plurality of locations to a collimated image of a source of electromagnetic radiation wherein said step of exposing further includes moving said collimated image across said photoresist layer in a 2-dimensional raster manner at a variable speed thereby providing differing exposure doses to said plurality of individual sites

developing said first photoresist layer thereby removing said exposed portions of said photoresist layer and exposing a portion of said silicon substrate, said portions of said photoresist layer not exposed to said collimated image remaining intact;

anisotropically etching said exposed portions of said silicon substrate with a first reactive plasma for a first period of time;

etching said undeveloped photoresist portions with a second reactive plasma for a second time to remove an incremental part of said undeveloped portion of said photoresist layer, said second reactive plasma exposing additional portions of said silicon substrate;

repeating said steps of etching until a plurality of etched cavities extending into said substrate thickness are provided, wherein said cavities have one or more surfaces comprising non-prismatic surfaces, and wherein some of said surfaces extend to different depths into said substrate thickness;

removing remaining portions of said photoresist layer;

depositing a thin first layer comprising a metal or metals onto said silicon top surface and onto said etched walls and bases;

depositing a thicker second metal layer over said first layer such that said etched structures are completely filled to form a plurality of metal structures; and

removing said silicon substrate to provide an embossing tool.

2. The method of claim **1**, wherein said step of etching with a first reactive plasma and said step of etching with a second reactive plasma comprises etching with a low pressure gas.

3. The method of claim **2**, wherein said step of etching with a first reactive plasma comprises etching with SF_6 and said step of etching with a second reactive plasma comprises etching with O_2.

4. The method of claim **2**, wherein said gas pressure gas is between about 20 to 50 mTorr.

5. The method of claim **3**, wherein said first and second periods of time are between about 2 to 10 seconds.

6. An embossing tool formed by the method of claim **1**.

7. The embossing tool formed by the method of claim **6**, wherein said metal structures comprise one or more 3-dimensional projections, each of said one or more 3-dimensional projections having one or more surfaces, wherein some of said surfaces are non-prismatic surfaces.

8. The embossing tool of claim **7**, wherein said 3-dimensional projections are wall-like or post-like or both.

9. The embossing tool of claim **7**, wherein said 3-dimensional projections have cross sections that are rectangular, triangular, trapezoidal, or parabolic or hyperbolic.

10. The embossing tool of claim **7**, wherein some of said non-prismatic surfaces are curvilinear.

11. The embossing tool of claim **7**, wherein some of said surfaces intersect to form an edge or a corner.

12. An x-ray mask tool, comprising:

a silicon substrate having a thickness, a top surface, and a bottom surfaces substantially parallel to said top surface, said silicon substrate comprising one or more open cavities etched into said top surface and extending into said substrate thickness, each of said one or more open cavities having one or more surfaces wherein some of said surfaces are non-prismatic surfaces, said surfaces extending to different depths into said substrate thickness, said open cavities filled with a metal deposit to provide a plurality of metal structures embedded into said silicon substrate.

13. The x-ray mask tool of claim **12**, wherein said open cavities are trench-like or hole-like or both.

14. The x-ray mask tool of claim **13**, wherein said open cavities have cross sections that are rectangular, triangular, trapezoidal, or parabolic or hyperbolic.

15. The x-ray mask tool of claim **12**, wherein some of said non-prismatic surfaces are curvilinear.

16. The x-ray mask tool of claim **12**, wherein some of said surfaces intersect to form an edge or a corner.

17. The x-ray mask tool of claim **12**, wherein said metal deposit is a metal selected from the group consisting of the Transition series of metals listed in New IUPAC Group Numbers 4 – 12 of the Period Table of elements, aluminum, tin, and alloys thereof.

18. The x-ray mask tool of claim **12**, wherein said metal deposit consists essentially of gold.

19. The x-ray mask tool of claim **17**, wherein said metal deposit comprises a thin vapor deposited first metal layer.

20. The x-ray mask tool of claim **19**, wherein said vapor deposited first metal layer comprises a first layer of chromium.

21. The x-ray mask tool of claim **19**, wherein said metal deposit is deposited by electroplating.

22. The x-ray mask tool of claim **19**, wherein said metal deposit is deposited by electroless deposition.

23. The x-ray mask tool of claim **19**, wherein said metal deposit is deposited by thermal or particle vapor deposition, or by sputter deposition.

24. A method for fabricating an x-ray mask tool, comprising the steps of:

providing a silicon substrate;

forming a first photoresist layer onto a top surface of said substrate;

exposing a portion of said photoresist layer at a plurality of locations to a collimated image of a source of electromagnetic radiation wherein said step of exposing further includes moving said collimated image across said photoresist layer in a 2-dimensional raster manner at a variable speed thereby providing differing exposure doses to said plurality of individual sites

developing said first photoresist layer thereby removing said exposed portions of said photoresist layer and exposing a portion of said silicon substrate, said portions of said photoresist layer not exposed to said collimated image remaining intact;

anisotropically etching said exposed portions of said silicon substrate with a first reactive plasma for a first period of time;

etching said undeveloped photoresist portions with a second reactive plasma for a second time to remove an incremental part of said undeveloped portion of said photoresist layer, said second reactive plasma exposing additional portions of said silicon substrate;

repeating said steps of etching until a plurality of etched cavities extending into said substrate thickness are provided, wherein said cavities have one or more surfaces comprising non-prismatic surfaces, and wherein some of said surfaces extend to different depths into said substrate thickness;

removing remaining portions of said photoresist layer;

depositing a thin first layer comprising a metal or metals onto said silicon top surface and onto said etched walls and bases;

depositing a thicker second metal layer over said first layer such that said etched structures are completely filled; and

planarizing said substrate top surface to remove said metal layers from said top surface to provide an variable dose x-ray mask.

25. The method of claim **24**, wherein said step of etching with a first reactive plasma and said step of etching with a second reactive plasma comprises etching with a low pressure gas.

26. The method of claim **25**, wherein said step of etching with a first reactive plasma comprises etching with SF_6 and said step of etching with a second reactive plasma comprises etching with O_2.

27. The method of claim **25**, wherein said gas pressure gas is between about 20 to 50 mTorr.

28. The method of claim **27**, wherein said first and second periods of time are between about 2 to 10 seconds.

29. The method of claim **24**, wherein the steps of depositing first and second metal layer includes depositing a metal selected from the group consisting of the Transition series of metal listed in New IUPAC Group Numbers 4 – 12 of the Period Table of elements, aluminum, tin, and alloys thereof.

30. The method of claim **24**, wherein the first step of depositing comprises depositing a metal layer by particle or thermal vapor deposition.

31. The method of claim **30**, wherein said first step of deposition further includes depositing a layer of chromium followed by depositing a layer of gold.

32. The method of claim **24**, wherein the second step of depositing comprises depositing a metal layer by electroplating.

33. The method of claim **32**, wherein said second step of deposition includes electroplating a layer of gold.